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Techno-Economic Feasibility Study of Management Palm-Oil Fronds Into Compost and Mulch in West Aceh District

Studi Kelayakan Tekno-Ekonomi Pengelolaan Pelepah Sawit Menjadi Kompos Dan Mulsa di Kabupaten Aceh Barat

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Abstract

The development of palm-oil plantations aims to create employment opportunities, improve the prosperity of community and income country. However, palm-oil plantation waste in the form of fronds has not been optimally managed. The aims of this research is to study of palm-oil fronds management feasibility in palm-oil plantations to be compost and mulch. The goals of this research is to study of palm-oil fronds management feasibility in palm-oil plantations to be compost and mulch. The study was conducted on one of the palm-oil plantations in West Aceh District. The techno-economic feasibility study refers to the use of all the necessary equipment and machinery in the management of palm-oil fronds. Factors to be considered in techno-economic analysis are NPV, Net B/C, IRR, Payback Period and BEP. The palm-oil plantation area studied is 576 which has the potential to produce as palm-oil fronds as much as 781 unit/day. Palm-oil fronds management uses two scenarios: centralized management scenarios (designed for only one processing unit) and decentralization (designed into two processing units). The results show that the techno-economic criteria of NPV, Net B/C, IRR, payback period and BEP for scenario one are Rp 766,518,333; 1.25; 25%; 8.09 years; 23,290.72 tons, respectively. The techno-economic criteria of NPV, Net B/C, IRR, payback period and BEP for scenario two are Rp 487,406,792; 1.07; 15%; 14.23 years; 40,935.51 tons, respectively. The value of these techno-economic criteria suggests that the management of palm-oil fronds from centralized scenarios is more feasible to undertake than the decentralization scenario.

Keywords: Aceh; compost; palm-oil fronds; plantation mechanization, mulch

INTRODUCTION

The development of palm-oil plantations aims to create employment opportunities, improve the prosperity of community and income country. Selection of

palm oil commodity to become a mainstay commodity from estate subsector because considering the amount of benefits that can be obtained from this commodity. Since 2004, the use of palm oil commodities has occupied the highest position in the world vegetable oil market which reached about 30 million tons with an average growth of 8% per year. it is better than soybean oil commodity around 25 million tons with an average growth of 3.8% per year (Kemenperin 2015). Palm-Oil Plantation activities proved to survive the economic crisis. Palm-oil plantations are also capable of recovering earlier than other economic activities from other sectors so as to serve as a buffer for national development (Triyanto 2008).

Palm-oil plantation wastes have not been managed optimally. Palm-oil frond just piled between trees without any further management. Palm-oil frond is piled between plant so that the track is impossible to cross. Palm-oil is a source of organic material that can be processed into compost. The management of palm oil into compost requires a techno-economic assessment to determining the best management that can be do it. Therefore, the purpose of this study is to conduct a techno-economic feasibility study of palm oil processing to compost and mulch in palm-oil plantations in West Aceh District.

RESEARCH METHOD

Locations of Research

The research location is in PT Agro Sinergi Nusantara Regency of West Aceh, Aceh Province. The district is located at coordinates latitude of 04°06' - 04°47' E and longitude of 95°52' - 96°30' E.

Stages of Research and Data Analysis

The research activities include:

1. Identify research location. This includes the cultivation system of oil palm crops, the mechanization activities and palm oil management system;
2. Analyze the needs of equipment and machinery in processing of palm-oil frond;
3. Techno-economic analysis of palm-oil frond processing activities into compost and mulch.

The data of palm-oil frond processing management is analyzed with two scenarios, ie :

1. Centralization scenarios. Analysis of data on the management of palm-oil frond with palm oil management unit is done centrally in one palm-oil plantation;
2. The decentralization scenario. Data analysis with palm-oil frond management unit located in several blocks in oil palm plantation.

Techno-Economic Analysis

Analysis of Cost total of palm-oil frond management is calculated by component of fixed cost and variable cost. The total cost is calculated using Equation 1 (Irwanto 1982; Daywin *et al.* 1993). *Net present value* (NPV) is calculated using Equation 2, *net benefit cost* (*Net B/C ratio*) is calculated using Equation 3, *internal rate of return* (IRR) is calculated using Equation 4, *payback period* is calculated using Equation 5 and *break event point* (BEP) is calculated using Equation 6 (Nurmalina *et al.* 2010).

$$Bp = \left(\frac{Bt}{X} + Bv \right) \quad (1)$$

$$NPV = \sum_{t=1}^n \frac{Bt - Ct}{(1 + i)^t} \quad (2)$$

$$\text{Net B/C} = \frac{\sum_{t=1}^n \frac{Bt - Ct}{(1+i)^t}}{\sum_{t=1}^n \frac{Bt - Ct}{(1+i)^t}} \quad (3)$$

$$\text{IRR} = i_t + \frac{NPV_1}{NPV_1 + NPV_2} \times (i_2 - i_1) \quad (4)$$

$$PBP = \frac{v(1+i)^n}{I} \quad (5)$$

$$BEP = \frac{TFC}{(P - VC)} \quad (6)$$

RESULTS AND DISCUSSIONS

Land Management Area of Palm stem

An analysis of the composting area is calculated to obtain the minimum requirement of the area for the palm-oil frond management. The area of land that must be prepare for the composting process is storage of palm-oil frond, area for chopper and compression palm-oil frond proces, storage of mulch raw material, storage of compost raw material, field for mixing raw materials, area for fermentation, raw material warehouse and compost warehouse (Figure 1). The total area requirements are presented in Table 1.

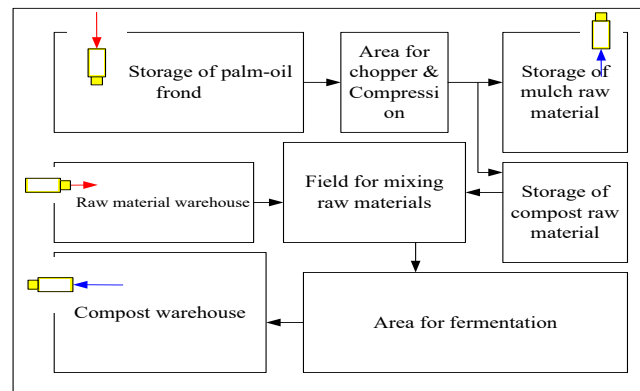


Figure 1 Layout of palm-oil frond processing area

Table 1 The minimum land requirement for processing of palm-oil frond

| No | Item | Area (m ²) | | |
|--------------|--|------------------------|--------------|--------------|
| | | Scenario 1 | Scenario 2 | |
| | | | Region A | Region B |
| 1 | Storage of palm-oil frond | 30.74 | 30.74 | 24.06 |
| 2 | Area for chopper and compression palm-oil frond proces | 12.00 | 12.00 | 8.00 |
| 3 | Storage of mulch raw material | 22.30 | 22.30 | 17.72 |
| 4 | Storage of compost raw material | 30.04 | 30.04 | 23.53 |
| 5 | Field for mixing raw materials | 6.93 | 6.93 | 6.20 |
| 6 | Area for fermentation | 7,617.04 | 5,056.42 | 5,916.62 |
| 7 | Raw material warehouse | 5.25 | 5.25 | 4.93 |
| 8 | Compost warehouse | 6.58 | 6.58 | 5.93 |
| Total | | 7,731 | 5,170 | 6,007 |

First Scenario Feasibility Analysis

The first scenario model assumes that the palm-oil frond processing is at the afdeling center point. The potency of palm-oil frond from all blocks area will be transported to the center of palm-oil frond processing. Maximum palm-oil frond occurs on the first day and second day of each week ie 781 palm-oil frond. The income derived from palm oil processing activities in this model is compost production times compost price. Based on the above, income is obtained every year starting from the third year of Rp 2,877,633,163 from the processing unit of palm-oil frond.

The investments include the construction of a palm-oil fronds processing, the purchase of equipment and machinery, equipment, wells, electrical installations and other supporting facilities. The total investment and reinvestment cost to be paid by the owner in the first scenario is Rp 3,842,031,932. The investment cost of scenario one on the provision of premises and the procurement of machines to manage the palm-oil frond is 98.90% of the total investment cost. In this study there is a reinvestment cost that is the cost incurred when the economic life of an asset is less than the project age. The total reinvestment cost incurred during the processing of palm-oil frond into mulch and compost is Rp 952,305,000. Total cost of labor in the first scenario is Rp 926,400,000 per year..

The results of the financial feasibility analysis show the first scenario is feasible to running. One scenario feasibility analysis reviewed from NPV (Rp 766,518,333) shows that businesses with first scenario are feasible to running because NVP has been greater than 0 with a payback period of 8.09 years and the amount of compost to be produced is 23,290.72 tons. Followed by Net B / C that is 1.25 has been declared feasible to running because it is larger than one. If the investment uses loan with interest rate of 13% bank, the processing of palm-oil frond into mulch and compost is also feasible because IRR (25%) is larger than the interest rate. Based on the results of the financial feasibility analysis can be concluded that the first scenario with the concept of palm-oil frond processing centrally feasible to run.

Feasibility Analysis Second Scenario

The second scenario concept is to build two palm-oil frond processing units in one afdeling. The potential of palm-oil fronds from the all block will be divided into the palm-oil frond processing A and B. The amount of palm stem in A processing place is 1,562 frond/week. The amount of palm stem in ABS processing place is 2,343 frond/week. On the first and second day of each week, processing B will not operate because there is no supply of palm-oil frond. The processing place B will operate from

the third day until the sixth day when the processing place of palm-oil frond A is not operating.

Income earned from the processing of the second scenario are similar to the first scenario. The total investment cost is Rp 5,319,936,253. The investment cost in second scenario is greater than Rp 1,477,904,321 if it's compared to the first scenario investment cost. This is because the cost of building the palm-oil frond processing in the second scenario becomes larger from the first scenario. The reinvestment cost for the second scenario is Rp 1,264,610,000. The labor used in the second scenario differs from the first scenario. Palm-oil frond processing unit is divided into two units to make the labor needed more and more. Labor costs for the second scenario are Rp 1,204,650,000/year.

The results of the financial feasibility analysis show that the second scenario is feasible to be implemented. The feasibility analysis of the second scenario shows that NPV (Rp 487,406,792) with a second scenario is feasible to implement because NPV has greater than 0. The duration of payback period is 14.23 years making this scenario feasible to be implemented due to the duration of payback which is still at the life of economical. The compost to be produced to break even point (40,935.51 tonnes) is nearing maximum compost production from the processing unit. Furthermore, the net B / C parameter also shows 1.07 which means that the processing with this second scenario is feasible to be implemented. If the investment uses loan with interest rate 13% then the processing of palm-oil frond into mulch and compost is also feasible because IRR (15%) is larger than the interest rate given by the bank. Based on the results of financial feasibility analysis can be concluded that the second scenario with the concept of palm-oil frond processing model is located in two places on one afdeling still feasible to be implemented.

CONCLUSIONS

1. The potential of palm-oil frond with an area of 576 ha is 3,905 frond/week. Palm leaves from the plantation can produce compost as much as 2,510,687.7 kg/year.
2. The financial feasibility analysis of the NPV parameters of each scenario shows that processing of palm-oil frond is mechanically feasible to be implemented because the NPV was greater than 0.
3. The payback period using the second scenario is longer than 6.14 years when compared to the first scenario.
4. The amount of compost that must be generated to break even in the second scenario is 17,644.79 tons larger than the first scenario.
5. The cost of producing compost in the first scenario is less than Rp 161.14/kg compared to compost production cost in the second scenario.
6. Under normal production level conditions (tenera varieties), palm-oil frond processing into compost and mulch mechanically using centralized scenarios is more feasible to implement than the second scenario in terms of techno-economic analysis parameters. However, the second scenario can absorb more labor than the first scenario.

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